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EXAMINER

MOHAMEDULLA, S

ART UNIT

PAPER NUMBER

1756

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Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trad marks

Office Action Summary

Application No.

09/320,946

Applicant(s)

KAMON, KAZUYA

Examiner

Saleha R. Mohamedulla

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 04 April 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-28 is/are pending in the application.
- 4a) Of the above claim(s) 25 and 26 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-24 and 27-28 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

- 15) ☐ Notice of References Cited (PTO-892)
- 16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 17) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 18) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 19) ☐ Notice of Informal Patent Application (PTO-152)
- 20) ☐ Other:

DETAILED ACTION

Claims 1-28 are pending. Claims 25 and 26 are withdrawn from consideration.

Continued Prosecution Application

1. The request filed on April 4, 2001 for a Continued Prosecution Application (CPA) under 37 CFR 1.53(d) based on parent Application No. 09/320,946 is acceptable and a CPA has been established. An action on the CPA follows.

Claim Objections

2. Claim 13 is objected to because of the following informalities: Claim 13, line 2 recites the phrase "half time." It appear "time" should be "tone." Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 13 and 15 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

4. Claims 13 and 15 recite the phrase "large area section" in lines 4 and 3, respectively. It is unclear as to what is meant by or encompassed in the word "large." Correction is required.

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Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

5. Claims 7, 22, 23 and 28 are rejected under 35 U.S.C. 102(b) as being anticipated by US# 5,437,947 to Hur et al.

Hur teaches an edge enhancement or highlighting phase shift mask with auxiliary shifters. The mask is a Levenson mask. The mask also includes a phase shift pattern of a shifter shading type with a shade pattern.

To form the mask, Hur teaches a transparent quartz substrate is coated with a patterned photoresist film. The photoresist is a mask to form a trench in the substrate by etching the substrate. The photoresist is removed, and chrome, a light-shading material, is deposited over the substrate, filling the trench in the substrate. Chemical and mechanical polishing is performed to form a smooth surface for the transparent substrate. This makes the opaque layer as high as the quartz layer. An oxide phase shifting layer is then deposited and is coated with a photoresist that is patterned. The photoresist is a mask to pattern the underlying oxide layer and the photoresist is removed (Figs. 9A-9F; col. 5, lines 3-25). The limitation in claim 7 drawn to the method of forming the phase shift pattern does not materially limit the photomask itself. The photomask of Hur includes a phase shift pattern.

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Hur also teaches in another embodiment forming a patterned photoresist layer over a transparent substrate and etching the substrate to form grooves. The resist is eliminated and a light shading material is deposited over the substrate, filling the trench in the substrate. Chemical and mechanical polishing is performed to form a smooth surface for the transparent substrate. A phase shifting oxide layer is formed over the substrate and a patterned photoresist 27 is formed over the oxide layer 26. The resist layer 27 is used to form phase shifter pattern 28 in fig. 5f. The substrate is then etched to form grooves 29 in Fig. 5h (col. 4, line 30-50; Figs. 5a-5h)

6. Claims 2, 5, 7, 9-11, 14, 15, 17-23 and 28 are rejected under 35 U.S.C. 102(e) as being anticipate by US# 5,824,439 to Lee (herein referred to as Lee '439).

Lee '439 teaches a method of manufacturing a phase shifting mask. A groove is formed in a transparent substrate. A light shading or a light-shielding layer is formed in the groove, creating a shade pattern with a shade section made up of a shade film formed in the hollow groove section. A phase-shifting layer is formed and patterned on the light shading layer (col. 4, lines 3-24). The phase shift mask of Lee '439 is a Levenson phase shift mask with auxiliary shifters and enhances the phase shifting effect at the edge portion. The mask also includes a phase shift pattern of a shifter shading type with a shade pattern.

To form the phase shifting mask, a silicon oxide or nitride layer is formed on the transparent substrate and is patterned with electron beam exposure to expose predetermined positions of the transparent substrate (col. 5, lines 10-15). A polymer layer is then coated over the silicon oxide or nitride patterned layer and the substrate. The layer is etched back with reactive ion etching to form sidewalls 35 (Fig. 4B). The grooved hollowed section in the

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substrate is formed by using the oxide or nitride layer and the sidewalls as a mask during reactive ion etching (col. 5, lines 15-28). The sidewalls are then removed. A light-shading material is deposited to fill the hollow section. The material and the substrate are polished and planarized through chemical-mechanical polishing. Part of layer is oxidized to form a phase shifting layer. The part that is not oxidized is a light-shading layer. The light-shading layer is defined to be within the groove. The oxide or nitride layer is then selectively removed to expose portions of the transparent substrate, thereby forming light transmitting portions (col. 5, lines 29-65)..

Lee '439 teaches that through a chemical-mechanical polishing method, the opaque layer and transparent layer are planarized. Lee '439 also teaches that CMP is used to planarize the phase-shifting layer (col. 5, lines 30-35 and 55-65; col. 6, lines 54-56).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 2, 5, 9-11, 14, 15, and 17-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,437,947 to Hur et al. in view of US# 5,824,439 to Lee (Lee '439).

Hur teaches the limitations discussed in paragraph 5 above. Hur does not teach that the surface of the phase shift layer is planarized. Lee '439 teaches a phase shifting mask with opaque material deposited in a pattern of grooves in a transparent substrate, and a phase shifting

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layer deposited on the opaque material. The phase shifting layer is planarized by chemical mechanical polishing (col. 5, lines 30-35 and 55-65; col. 6, lines 54-56).

The references are analogous art as they are drawn to phase shifting masks. It would have been obvious to one of ordinary skill in the art to planarize the phase-shifting layer of Hur to improve adhesion between the opaque and phase shifting layer and improve the planarity of the surface of the phase-shifting layer (col. 6, lines 55-60).

8. Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,437,947 to Hur et al. or US# 5,824,439 to Lee (Lee '439) in view of US# 5, 945,237 to Tanabe.

Hur or Lee '439 teaches the limitation discussed above in paragraphs 5 and 6 above. Hur or Lee '439 does not teach that the phase shifting layer is a reflection preventing film. Tanabe teaches a phase shifting mask having a phase shifting layer. Tanabe teaches that the phase shifting layer is a translucent layer and may be made of chrome oxide or molybdenum silicide oxide/nitride (col. 13, lines 30-40). These materials are reflection preventing material.

The references are analogous art as they are drawn to phase shifting masks. It would have been obvious to one of ordinary skill in the art to use the reflection-preventing phase-shifting material of Tanabe as the phase-shifting material of Hur or Lee '439 in order to improve phase mask resolution using a simply constructed mask (col. 1, lines 19-28).

9. Claim 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,824,439 to Lee (Lee '439) in view of US# 6, 017, 659 to Lee et al (herein referred to as Lee '659).

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Lee '439 teaches the limitations of claim 2 discussed in paragraph 6 above. Lee '439 does not teach that the phase-shifter is formed of multiple steps. Lee '659 teaches a phase shifting mask, wherein the difference of a step between the phase shift pattern and the substrate gradually decreases yielding an intermediate or transition phase shifter (Figs. 8D-8G; col. 1, line 62; col. 3, lines 1-20).

The references are analogous art as they are drawn to manufacturing semiconductor devices using phase shift masks. It would have been obvious to one of ordinary skill in the art to use the method resulting in a stepped structure of Lee '659 in the mask of Lee '439 in order to eliminate the need for using extra masking steps (col. 2, lines 65-68). Lee '439 teaches that the phase shifting layer is planarized by chemical-mechanical polishing, and therefore it would be obvious to planarize the stepped phase shifting layer with chemical mechanical polishing.

10. Claims 3, 4, 6 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,824,439 to Lee (Lee '439) in view of US# 5,972,540 to Lee (herein referred to as Lee '540).

Lee '439 teaches the limitations of claims 2, 5 and 7 discussed in paragraph 6 above. Lee '439 does not teach that an end section of the phase shift pattern has a sloped shape that decreases.

Lee '540 teaches phase shift patterns that are rounded into sloped phase shift patterns on a transparent substrate (col. 5, lines 20-25, Fig. 10d). Lee teaches that this phase shift patterns are chemically mechanically polished to prevent occurrence of pattern error at the 180 degree/0 degree boundary (col. 2, lines 60-68 and col. 4, lines 45-55). The chemical mechanical polishing is used to form the planar tops and rounded sidewalls.

The references are analogous art as they are drawn to manufacturing semiconductor devices using phase shift masks. It would have been obvious to one of ordinary skill in the art to use the sloped phase-shifters of Lee '540 in the mask of Lee '439 in order to prevent pattern errors at a phase boundary (col. 2, lines 65-68).

11. Claims 3, 4, 6 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,437,947 to Hur et al. in view of US# 5,824,439 to Lee (Lee '439), in further view of US# 5,972,540 to Lee (herein referred to as Lee '540).

Hur in view of Lee '439 teaches the limitations of claims 2, 5 and 7 discussed in paragraph 5 and 7 above. Hur does not teach that an end section of the phase shift pattern has a sloped shape that decreases.

Lee '540 teaches phase shift patterns that are rounded into sloped phase shift patterns on a transparent substrate (col. 5, lines 20-25, Fig. 10d). Lee teaches that this phase shift patterns are chemically mechanically polished to prevent occurrence of pattern error at the 180 degree/0 degree boundary (col. 2, lines 60-68 and col. 4, lines 45-55). The chemical mechanical polishing is used to form the planar tops and rounded sidewalls.

The references are analogous art as they are drawn to manufacturing semiconductor devices using phase shift masks. It would have been obvious to one of ordinary skill in the art to use the sloped phase-shifters of Lee '540 in the mask of Hur in order to prevent pattern errors at a phase boundary (col. 2, lines 65-68).

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12. Claims 12 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,824,439 to Lee (Lee '439) in view of US# 5, 945,237 to Tanabe.

Lee '439 teaches the limitations of claim 2 discussed in paragraph 6 above. Lee '439 does not teach that the phase shift pattern is a half tone phase shift pattern.

Tanabe teaches a half tone phase shift pattern (col. 1, lines 30-40).

The references are analogous art as they are drawn to manufacturing semiconductor devices using phase shift masks. It would have been obvious to one of ordinary skill in the art to use the half tone pattern of Tanabe in the mask of Lee '439 in order to improve phase mask resolution using a simply constructed mask (col. 1, lines 19-28).

13. Claims 12 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,437,947 to Hur et al. in view of US# 5,824,439 to Lee (Lee '439), in further view of US# 5, 945,237 to Tanabe.

Hur in view of Lee '439 teaches the limitations of claim 2 discussed in paragraph 7 above. Hur in view of Lee '439 does not teach that the phase shift pattern is a half tone phase shift pattern.

Tanabe teaches a half tone phase shift pattern (col. 1, lines 30-40).

The references are analogous art as they are drawn to manufacturing semiconductor devices using phase shift masks. It would have been obvious to one of ordinary skill in the art to use the half tone pattern of Tanabe in the mask of Hur in order to improve phase mask resolution using a simply constructed mask (col. 1, lines 19-28).

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14. Claims 16 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over US# 5,437,947 to Hur et al. or US# 5,824,439 to Lee (Lee '439) in view of US# 5,945,237 to Tanabe, in further view of US# 6,037,083 to Mitsui.

The combination of Hur or Lee '439 in view of Tanabe teaches the limitations discussed in paragraph 8 above. It is obvious to a skilled artisan to use an electron beam, a laser beam or monochromatic beam as radiation to expose the photoresist as these forms of radiation are commonly used in the art to pattern photoresists.

The references do not teach forming a second reflection preventing film on the phase shifting layer. Mitsui teaches a second reflection preventing metal film on a phase shifting half tone film to create a half-tone phase shifting mask (Fig. 10, col. 11, lines 27-30).

The references are analogous art as they are drawn to manufacturing semiconductor devices using phase shift masks. It would have been obvious to one of ordinary skill in the art to use the second reflection preventing film of Mitsui in the mask of Hur or Lee '439 in order to be able to properly etch the underlying phase shift material and yield improved optical characteristics. The second layer of Mitsui exhibits high acid resistance and high reliability (col. 2, lines 48-65).

Response to Arguments

15. Applicant's arguments with respect to claims 1-24 and 27-28 have been considered but are moot in view of the new ground(s) of rejection.

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Conclusion

16. Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Saleha Mohamedulla whose telephone number is (703) 308-1260. The Examiner can normally be reached Monday through Friday, from 8:00am to 4:30pm. If attempts to reach the Examiner by telephone are unsuccessful, the Examiner's supervisor, Mark Huff, can be reached on (703) 308-2464. The fax phone number for the organization where this application or proceeding is assigned is (703) 305-3599. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

srm



June 18, 2001



MARK F. HUFF
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